Forest Health Protection
Pacific Southwest Region

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To: Dave Myers, Forest Supervisor Shasta-Trinity National Forest

Subject: Chalk Mountain Plantation Thin and Underburn Project

At the request of Todd Hamilton, Silviculturist Shasta lake District, a site visit was made to Chalk Mountain Late-Successional Reserve (CMLSR) on December 5, 2017, where there is a proposal to treat approximately 2,525 acres as a Farm Bill/Insect & Disease CE: Title VI, Section 603. The objectives of the visit were to assess the current stand conditions for insect and disease activity and discuss suitability for the designation and future WBBI funding. Todd Hamilton, Todd Johnson (Shasta-Trinity NF), Pete Angwin, and Cynthia Snyder (FHP) were present.

Background

The planning area is located approximately five mile east of the community of Beg Bend (Shasta County) near the 37 Road (37N02) connecting Big Bend and Lake Britton (see map in appendix). Project units are within the Pit Management Area (#11) of the Shasta-Trinity National Forest's Land and Resource Management Plan (LRMP). Although the project is partially within designated Tier 2 High Hazard Zone (Pit River and Potem Creek watersheds), possible complications for the project based on location include:

- the entire project is within the Chalk Mountain Late Successional Reserve (CMLSR),
- the entire project is within the 100 square mile Pit River Tribe ancestral ground,
- the project area is mostly within critical habitat for northern spotted owl, and
- the entire project is within the Wildland Urban Interface (WUI) characterized by private lands, residential structures (Big Bend), and hydroelectric improvements (PG&E)

The CMLSR is considered transitional between typical Klamath province and Southern Cascade type. Soils are well drained and average rainfall ranges between 40-70 inches per year between Lake Britton and the upper Rock Creek watershed. Most precipitation falls in the winter as snow. Slopes range from flat to 80% and elevation ranges from 2,000-5,000 feet.

Three needs were identified based on similarities in the Forest Plan direction, watershed analysis within the Chalk Mountain Comprehensive Late Successional Reserve Assessment (CLSRA), traditional ecological knowledge provided by the Pit River Tribe, and the initial vegetation assessment:

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1) Restoration of forest stand structure and diversity by reducing stand densities to allow greater individual tree growth and development.

> *Forest stand densities are managed at levels to maintain and enhance growth and yield to improve and protect forest health and vigor recognizing the natural role of fire, insects and disease, and other components that have a key role in the ecosystem (LRMP p. 4-126).*

2) Maintain and increase Late-successional habitat and reduce overall fuel levels and continuity to reduce the potential for uncharacteristic stand replacement fires, restoration of more natural fire regimes.

> *Maintain and increase the amount of late-successional habitat from loss due to stand-replacing fire (CLSRA p. 43).*
>
> *Late successional forest stands are managed to maintain health and diversity components through use of prescribed fire and thinning from below (LRMP p. 4-126).*

3) Restore eco-cultural systems which tribal community depends upon for subsistence purposes, through integration of modern restoration practices and traditional ecological knowledge.

> *Prescribed burning to rejuvenate bear grass for Native American use (CLSRA p. 55).*

Currently 55 plantation stands (1,525 acres) and three burn blocks (2,025 acres) have been delineated within the project area. Plantation ages range 25-47 years, most originated from regeneration harvests planted to ponderosa pine (*Pinus ponderosa*) with some north-facing slopes and drainages planted to Douglas-fir (*Pseudotsuga menziesii*). Site preparation methods at that time for the 55 stands included burning, windrows, and herbicide (2, 4-D) with varying levels of success. Abundance and diversity of understory, including grasses, creeping snowberry (*Symphoricarpos mollis*), dogwood (*Cornus nutallii*), vine maple (*Acer circinatum*), deer brush (*Ceanothus integerrimus*), California black oak (*Quercus kelloggii*), and big leaf maple (*Acer macrophyllum*), appears to be a function of site preparation methods. The general forest outside of the plantations is mature mixed conifer containing ponderosa pine, Douglas-fir, sugar pine (*Pinus lambertiana*), white fir (*Abies concolor*), and incense cedar (*Calocedrus decurrens*).

Todd Hamilton determined that approximately 80% of the plantations (1,210 acres) were at or above the "zone of imminent mortality" (greater than 60% of maximum stand density index) and found small pockets (5-25 stems) of standing dead trees were occurring. He attributed the recent mortality to the combination of overstocked stands, recent drought, and western pine beetle (*Dendroctonus brevicomis*). His original assessment states basal area ranges 60-215 with an average of 160 and diameters at breast height range 8-16 inches.

Observations

The Chalk Mountain project area was presented to us as three successional stages. The first stand we visited (stand 1-18) was called "early succession" (35 years old) with high diversity, high density, and low mortality (Figure 1). Todd had earlier determined that the stand had a stand density index (SDI) of 220, mostly ponderosa pine with an average diameter of 10 inches dbh mixed with California black oak with a component of incense cedar and scattered Douglas-fir. The basal area (BA) of the stand was 260 square feet per acre (this included the oak) and there were a few scattered pines (less than 1 per acre) with some topkill, less than 1 foot, that may have been attributed to Ips species responding to the overstocking and the drought conditions that persisted through 2015. No current mortality due to Dendroctonus bark beetles was noted.

Figure 1. Stand 1-18, 35 year old ponderosa pine plantation with ingrowth of black oak and Douglas-fir. Some scattered topkill may be a result of Ips infestation.

The second stand we visited (stand 1-17) was somewhat older (40 years old) and larger with an average diameter of 15-16 inches dbh. This stand was denser, with a BA of 300, and less diverse than the first stand. There was much less oak and other species but still a mix of ponderosa pine with incense cedar, Douglas-fir, white fir, and California black oak (Figure 2). Trees were cored at this site to observe growth rate and discovered that the trees were still putting on about ½ inch of growth per year over the past 10-15 years, approximately half of the average growth observed earlier. No mortality was seen in this

stand and overall health looked remarkably good especially considering the stocking density.

Figure 2. Stand 1-17, a 40 year old ponderosa pine plantation showing high growth potential of the site. No observed mortality although very dense.

The third stand we visited (stand 3-3) was older, at 47 years old, one of the oldest in the project area. The stand was denser with a BA of about 340, and larger with an average diameter of 20 inches dbh (Figure 3). The stand was primarily ponderosa pine with some scattered incense cedar and Douglas-fir and an understory of dogwood. Tree mortality, caused by western pine beetle, was a common feature in this stand. Patches of 5-10 trees were scattered throughout (approximately 30 trees per acre) with much of the observed mortality occurring in the past 1-3 years evidenced by the amount of needle and small branch retention and presence of beetles (figure 4). Todd said many such patches occurred throughout the stand with a patch of about ¼ acre in size near the center. Many of the patches could be seen on Google Earth™ imagery from 2014-2016. Annual ADS show large polygons of western pine beetle-caused tree mortality (about 200 acres with 1-5 trees per acre affected in 2016) within the project boundary.

Figure 3. Stand 3-3, a 47 year old ponderosa pine plantation showing patches of mortality due to western pine beetle.

Figure 4. Western pine beetle found under bark of 21 inch ponderosa pine.

Although stumps were a common feature in all of the observed stands, no evidence of Heterobasidion root disease was found. The Forest Plan description of desired conditions and management objectives for the project area describe the promotion of late seral species and stand characteristics while maintaining

Discussion

The management objective within LSRs is to protect and enhance conditions of late-successional forest ecosystems, which serve as habitat for late-successional and old-growth related species including the northern spotted owl (USDA, USDI 1994b). Protection includes reducing the risk of large-scale disturbance, including stand-replacing fire, insect and disease epidemic, and major human caused impacts. The Forest-wide LSR Assessment describes the plantations greater than 20 years old within the mixed conifer series as planted with ponderosa pine or with a mixture of ponderosa pine and Douglas-fir with white fir and incense cedar seeding in naturally. It goes on to describe most of these plantations as very dense, with declining growth rates. The observed stands support this assessment made in 1999 (STNF 1999).

The project area as we observed it, is a great way to demonstrate the risk of bark beetles in various stand structures. The first stand was less dense with a high diversity of species including incense cedar and oak. In fact, the BA described (260 square feet per acre) included the oak. This diversity provides a buffer to bark beetle-caused mortality by producing competing chemical cues prior to colonization and disrupting pheromone plumes after colonization. The second stand visited illustrates the high growth capacity of the area. Continued growth as the stand becomes dense is an indication of tree vigor that helps reduce the risk of mortality due to bark beetle attack. The growth has shown a marked reduction but is not completely shut down as is seen in the third stand. The third stand represents the end game if thinning is not started. Hayes et al. (2009) reported that stand density, measured as basal area or stand density index (SDI) is the most important predictor of western pine beetle-caused tree mortality at large spatial scales in California. Thinning has long been advocated as a preventive measure to reduce the amount of bark beetle-caused tree mortality (Fettig et al. 2007). Todd discussed thinning the stand to a BA of 80-100 retaining the incense cedar and Douglas-fir over the pine and thinning the oak (in the first stand) to retain the best 3-5 stems per clump (McDonald 1969).

The proposed treatment includes 1,525 acres of plantation thinning including producing selective openings (i.e. group and patch cuts) in areas of tree mortality, with thinning between selective openings down to 60-100 BA or 30-35% of maximum SDI. This thinning would release clumps of non-pine natural regeneration and enhance hardwood growth and development through preference and radial thinning. Thinning treatments are intended to last a minimum of 20 years and underburning treatments across the 2,025 acres are intended to mimic the median fire return interval of 10-30 years.

The proposed project meets the Treatment Standards as described in the 2009 Regional Ecosystems Office memo clarifying the 1999 Late Successional Reserve Assessment:

a. The treatment is primarily a hazard reduction treatment designed to reduce large-scale loss of key late-successional structure; to increase diversity of stocking

levels and size classes within the stand or landscape; to increase tree size, crown development, or other desirable characteristics; to maintain vigor for optimum late-successional development; or to provide various stand components beneficial to late-successional forest-related species.

b. The treatment is primarily an improvement thinning in order to reduce the risk of large-scale disturbance. Release cutting for the purpose of regenerating a second canopy layer in existing stands is no more than an associated, limited objective as described below under opening and heavily thinned patches. Efforts need to be made to promote diversity of hardwood and conifer species. Most of the thinning in these types of stands will focus on removal of suppressed and intermediate trees. Occasional co-dominants will be removed in order to provide growing space for remaining trees. In some cases, smaller diameter trees may be favored over adjacent larger diameter trees in order to promote species diversity and/or structural diversity.

These stands represent different levels of risk of western pine beetle-caused mortality in ponderosa pine due primarily to overstocking, and thinning would benefit each differently. Thinning and favoring oak in the first would reduce the risk of pine mortality due to western pine beetle and provide increased mast production for wildlife as well as for Tribal benefit. Collaboration is a key component of the CE designation – Tribal cooperators will be invited to become saw and fire qualified for thinning the oak component. The second stand is at a higher risk but still growing at a good rate, the residual trees would be at an advantage to fully respond to the increased moisture, space, and nutrients provided by thinning. The third stand is beginning to unravel as the pines succumb to bark beetle attacks and overcrowding and shade tolerant species continue to seed in. As with most bark beetles, the most economical and efficient means of management is to maintain trees and stands in a healthy condition. Stocking reduction and creation of diverse stand conditions reduce overall susceptibility to western pine beetle. To this end the creation of selective openings through patch cuts and thinning to release the non-pine species and reduce density will provide the best opportunity to keep a functioning forest moving toward late succession characteristics in the older plantation stands. I fully support this project and look forward to participating in future planning.

If you have any questions regarding this report and/or need additional information, please contact Cynthia Snyder at 530-226-2437 or Pete Angwin at 530-226-2436.

/s/ Cynthia Snyder

CC: Todd Hamilton, Todd Johnson, Chris Losi, Sheri Smith, Phil Cannon, Chris Fischer, Sherry Hazlehurst, and Pete Angwin

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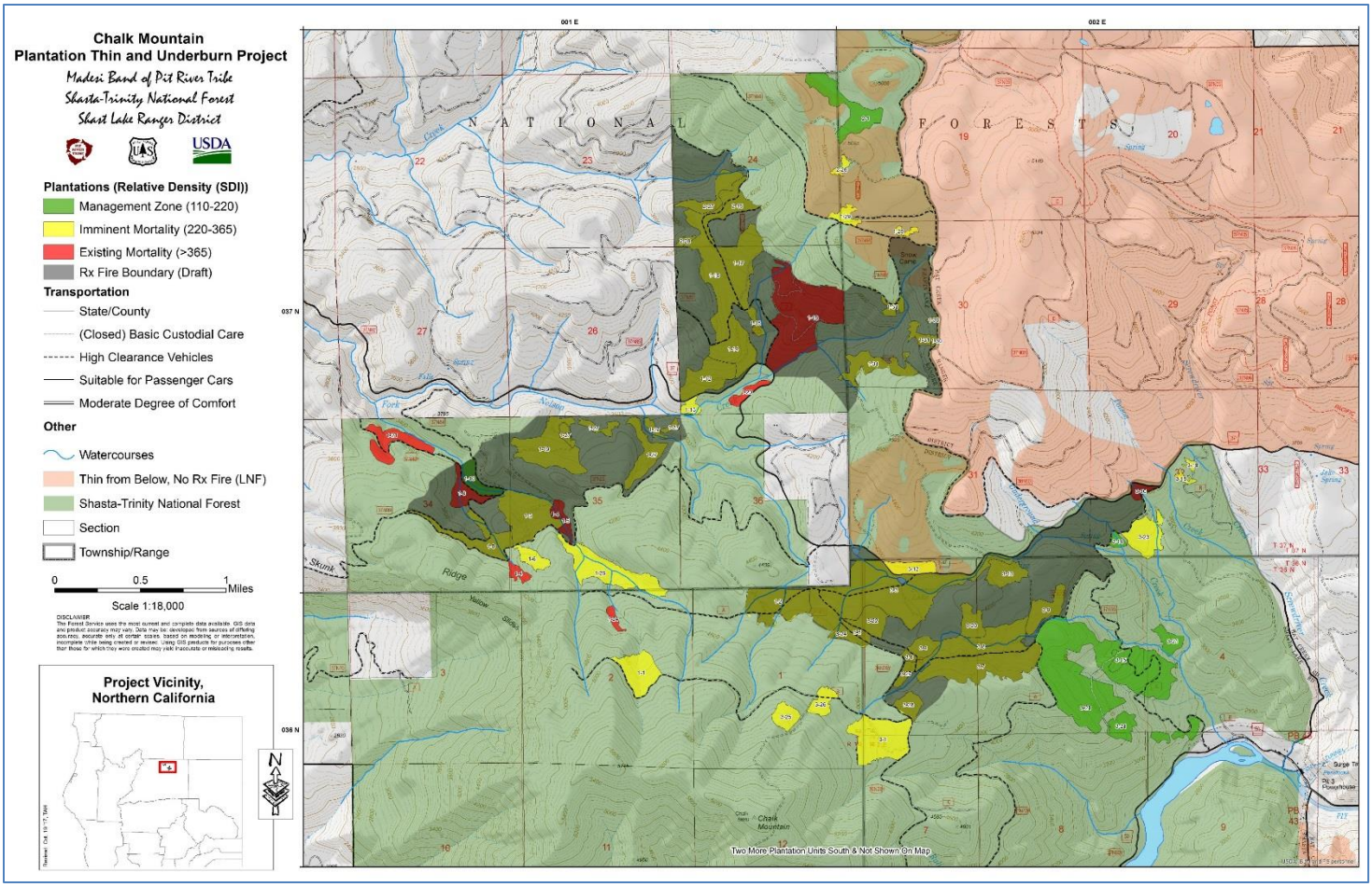
Appendix



Project map from the PIL

Western Pine Beetle

The western pine beetle, *Dendroctonus brevicomis* LeConte, can aggressively attack and kill ponderosa pine trees of all ages and vigor classes that are 6 inches (15 cm) or larger in diameter, including apparently healthy trees. Group killing of trees is common in dense, overstocked stands of pure, even-aged, young sawtimber, but also occurs among dense clumps of pine in stagnating mixed-conifer stands.

Usually, the beetles breed in and kill scattered, overmature, slow-growing, decadent, or diseased trees and trees weakened by stand stagnation, lightning, fire, or mechanical injury. This tree mortality may be considered part of the normal ecological process of succession through which a forest matures and replaces itself.

Pitch tubes, ¼ to ½ inch (6 to 13 mm) in diameter, formed on the tree trunk around entry holes made by attacking female beetles, are usually the first evidence of infestation. The pitch tubes are white to red-brown masses of resin and boring dust found in the crevices between the bark plates. Relatively few, widely scattered, white pitch tubes, 1 inch (25 mm) or larger in diameter, usually indicate that the attacks were not successful and that the tree will survive. Close examination of successfully attacked trees, however, tubes and dry, reddish-brown boring dust in the bark crevices and around the base of the tree.

Attacking adult beetles carry spores of a blue-staining fungus, Ceratocystis minor (Hedg.) Hunt, in special pouch-like structures in their heads called mycangia. As the beetles chew their way through the bark, the spores of this wilt-causing fungus dislodge and begin to germinate. In trees attacked in early or midsummer, it takes only a few weeks for the fungus to invade and block the conductive vessels of the inner bark and sapwood. Once the vessels are blocked, the foliage begins to fade, first to a pale green and then to yellow, straw, and sorrel. Finally, perhaps after a year, the foliage may turn red brown. This fading is the first evidence of damage to the tree that is visible at a distance.

In trees attacked in late summer or fall, the fungus develops more slowly, and many infested trees do not fade until the next spring. These green trees are often first seen to be infested when woodpeckers flake off the outer bark as they search for and feed on developing beetle larvae. This flaking exposes the bright-orange inner bark, making these trees visible from as far away as 300 feet (100 m).

Western pine beetles pass through the egg, larval, pupal, and adult stages during a life cycle that varies in length from about 2 months in warm weather to 10 months in cool weather. All stages are completed beneath or in the bark of infested trees, except for a brief period when the adults fly to find new trees to attack.

In the northern part of their range and at higher elevations, the beetles produce two generations each year, with attacks in early June and late August. In the South and at lower elevations, the beetles produce three and sometimes four generations each year, with attacks as early as March and as late as November.

The larvae are small white grubs that feed first in the phloem, where they construct a short gallery. They then mine into the middle bark where most of their development takes place. After completing four larval stages, they transform into pupae and then into adults. As these brood adults feed on the middle and outer bark, fungal spores collect in their mycangia. Once the adult insects emerge, they are ready to renew the attack-infestation cycle in living trees.

When the female beetles successfully attack a tree, they release minute amounts of behavioral chemicals into the air. These odors (pheromones) attract males and other females to the tree, causing a mass attack that tends to overcome the tree's natural resistance. If numerous beetles are flying and fair weather persists, adjacent trees may be attacked, resulting in a group of infested trees. Usually, an insufficient number of beetles are flying, or bad weather delays the arrival of more beetles to the vicinity of the newly attacked tree. Either of these conditions will usually result in the typically isolated dead tree.

Several conditions often work together to influence the number of beetles and the beetle-caused tree mortality in a given area. The availability of suitable host material - phloem and inner bark - is a key condition influencing western pine beetle outbreaks. Most trees are either too healthy or too weak to provide material in which beetle numbers can increase. Healthy trees can withstand many attacks before the beetles are successful, the brood is established, and new adult beetles are produced. Weak trees, such as those that have been smog damaged, diseased, or suppressed by competition, although easily killed, also produce relatively few beetles.

The thick, nutritious phloem and inner bark of healthy trees become host material for attacking western pine beetles when these trees undergo sudden and severe moisture stress. Healthy trees ordinarily produce abundant amounts of resin, which pitch out or eject attacking beetles. But, when suddenly deprived of moisture, stressed trees cannot produce sufficient resin flow to resist attack, and their nutritious food supply becomes available to beetles. In these trees, almost all attacking beetles can succeed and reproduce many times their number of offspring, increasing the beetle population to outbreak levels.

Moisture stress results when the water balance between the foliage and the roots changes dramatically. An imbalance may result from increased water loss from the needles (transpiration), decreased water uptake by the roots (physiological drought), or from a combination of the two.

Any condition that results in excessive demand for moisture, such as tree crowding, competing vegetation, or sudden exposure to severe sunlight; or any condition that reduces the ability of the roots to supply water to the tree, such as mechanical root damage, root disease, soil compaction, or drought, can cause moisture stress and increase susceptibility to attack by the western pine beetle.